

Groundwater Treatment Plant Performance Evaluation Report - Wyckoff/Eagle Harbor Superfund Site

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Process Narratives

The Wyckoff Groundwater Treatment Plant (GWTP) is designed to treat contaminated groundwater extracted from the upper aquifer located beneath the site, to levels specified by the Record of Decision (ROD), in order to maintain hydraulic control for the site. Extracted groundwater is pumped into an equalization (EQ) Tank from which the water is drawn and processed through three separate process treatment units. The treatment units (in order) are the dissolved air flotation (DAF) system with polymer injection; the hydromotion deep bed filter (HDBF) system; and the granular activated carbon (GAC) system. The DAF and HDBF systems are designed to remove oil and grease (O&G), total suspended solids (TSS), and polycyclic aromatic hydrocarbons (PAHs). The GAC units are designed to remove pentachlorophenol (PCP) and PAHs.

The major process components of the treatment system are:

- EQ system
- DAF system
- HDBF system
- GAC system
- Effluent tank

Additional side-stream components are:

- Solids processing system
- Filter press system
- Oil processing system
- Containment area system

The treatment equipment, along with appurtenances such as flow meters, level sensors, valves, and pressure gauges, are located either inside the enclosed treatment building or within the Tank Farm containment area, which is south of and adjacent to the treatment building. The treatment system uses a programmable logic controller (PLC) to facilitate automated system operation for treating contaminated water. The PLC, located inside the treatment building, communicates with and controls the process equipment. The system equipment can be operated either automatically by the PLC or manually at local control stations located near each specific piece of equipment.

Figure 1-1 (Process Flow Diagram) in Appendix A presents a schematic flow diagram of the overall treatment process, including the side-streams for process water recycling and waste removal and recovery. The side-streams include product recovery from the EQ Tank and the DAF system; backwash for the HDBF and GAC systems; solids recovery (filter press) from the backwash streams; stormwater, spill containment, and recycled water streams; and polymer, water, and air systems.

1.0 Equalization System

1.1 Overview

Groundwater extraction well (EW) pumps discharge contaminated, extracted groundwater into the EQ Tank located within the Tank Farm. The design influent flow rate for the Equalization System was 70 gallons per minute (gpm), with the majority of the flow, 57 gpm, from extracted groundwater and the original decontamination pad. Additional flows included stormwater from the containment area system, during a 25-year rainfall event), which was expected to be 7.6 gpm. The EQ tank also receives recycled filter backwash flow which was expected to be 6.8 gpm. The sum of these individual flow components is 71.4 gpm, which is slightly higher than the design flow of 70 gpm. Consequently, during a 25-year rainfall event, it may be necessary to reduce the extraction rate from the well field to accommodate the stormwater volume. During dry weather, when there is no pad runoff, up to 63 gpm of groundwater can be extracted and treated. It should be noted that the influent flow rate will decrease once the old treatment plant and its secondary containment system is demolished in the near future. Further, although the treatment plant design influent flow rate is 70 gpm, the treatment systems are capable of handling flow rates up to 80 gpm for short durations.

The EQ Tank provides equalization of flow and contaminant concentrations to the DAF system and also provides separation of non-aqueous-phase oil and settleable solids as a result of long hydraulic retention time. The EQ Tank is sized to provide more than 2 days of retention time at an influent flow of 11 gpm, which is the expected future peak flow rate after the site cap is installed.

The EQ Tank has a vertical baffle to reduce short-circuiting between the water influent and effluent points. The baffle also promotes settling of non-aqueous-phase liquid (NAPL) and suspended solids. The EQ Tank has an overflow weir for removal of light non-aqueous-phase liquid (LNAPL) and a sloped floor to facilitate the removal of dense non-aqueous-phase liquid (DNAPL) and settled solids. Hoses are connected to the EQ Tank to remove LNAPL and DNAPL. The product is then discharged to the EQ skim sump. The EQ skim sump allows for storage and handling of LNAPL, DNAPL, and water, where it is manually removed using the digester/skim pump.

Sampling port SP-0 is located on the plant influent (PLI) pipeline between the EWs and EQ Tank.

Contaminated water from the EQ Tank is sent to the DAF system, which is described in Section 2.0.

1.2 Design Parameters

Table 1-1 lists performance criteria for the EQ Tank. The influent design criteria for O&G, PCP, and PAH concentrations were based on the historical average influent concentrations

to the former GWTP between September 2003 and September 2004. The TSS design concentration was the assumed groundwater influent concentration to the former GWTP.

It is important to note that the design concentrations presented in Table 1-1 for the EQ tank effluent reflect the impact of the treatment plant recycle waste streams that also discharge into the EQ Tank. The design influent values only characterize the extracted groundwater concentrations. Therefore, the design influent values do not account for the concentration impacts due to these recycle waste streams. These recycle waste streams include flows from the following processes: dirty backwash water, stormwater, froth tank decant water, decontamination pads runoff water, and recovered product decant water. Even though these waste streams provide intermittent flow to the EQ Tank, the impact of these flow streams is reflected in the effluent concentrations. For example, for the O&G effluent concentration, there is an actual increase in the effluent concentration when compared to the influent concentration.

Table 1-2 lists the design parameters for the EQ system.

TABLE 1-1

EQ Tank Performance Criteria

GWTP Performance Evaluation Report -- Wyckoff/Eagle Harbor Superfund Site

Parameter	Design Influent Concentration ¹	Design Effluent Concentration ²
TSS (mg/L)	30	28
O&G (mg/L)	19	20
PCP (µg/L)	480	435
PAH (µg/L)	19,800	17,955

NOTES:

1 - Extracted groundwater only

2 – All flows including extracted groundwater, stormwater, decontamination pad water and recycle waste streams

TSS = total suspended solids

O&G = oil and grease

PCP =pentachlorophenol

PAH = polycyclic aromatic hydrocarbon

mg/L = milligrams per liter

µg/L = micrograms per liter

TABLE 1-2

EQ System Design Parameters

GWTP Performance Evaluation Report -- Wyckoff/Eagle Harbor Superfund Site

EQ Tank	
Number of Units	1
Dimensions	18-ft Dia x 27 ft High
Capacity	51,400 gallons

TABLE 1-1

EQ Tank Performance Criteria

GWTP Performance Evaluation Report -- Wyckoff/Eagle Harbor Superfund Site

EQ Skim Sump	
Number of Units	1
Dimensions	5 ft L x 5 ft W x 5 ft Deep
Capacity	935 gallons

1.3 Process Description

- Groundwater is pumped into the EQ Tank from the Wyckoff EW network. The EQ Tank also receives water from the Froth Tank, Stormwater Recycle Tank, Dirty Backwash Water Tank, old treatment plant pad, and Product Tank decant water.
- The liquid level in the tank is monitored by a level transmitter and maintained at a level of approximately 14 feet under normal operating conditions. The level was adjusted and optimized over the initial operating period to determine what level provided excess storage capacity if treatment processes must be temporarily shut down for maintenance while maintaining pumping from the extraction wells.
- Effluent water from the EQ Tank is pumped to the DAF system by the DAF feed pump.
- Approximately once per quarter, the water level in the EQ Tank is raised to the top of the working volume to decant floating LNAPL that accumulates on the water surface via the overflow weir. Decanted LNAPL is discharged by gravity flow to the EQ skim sump.
- DNAPL and heavy solids are drawn off the sloped bottom of the tank quarterly by opening the valve on the DNAPL outlet and allowing it to discharge to the EQ skim sump.
- Fluids in the EQ skim sump are pumped to the Product Tank or Froth Tank. If the fluid is virtually all oil, it is pumped directly to the Product Tank. If the fluid contains an appreciable amount of water, it will be pumped to the Froth Tank for further separation.

1.4 Performance Evaluation

Weekly sampling data collected from April 2009 to December 2010 were analyzed to compare equipment performance to design criteria. Results are shown in Appendix B, Table B-1. Constituent concentrations are represented as the monthly average of sampling data. Table B-1 also illustrates the average measured flow rates for selected major process streams in the treatment plant.

Table 1-3 lists the EQ Tank influent concentrations for O&G, PCP, and PAH. The design assumed an influent O&G concentration of 19 milligrams per liter (mg/L); however, an average monthly concentration of 26.7 mg/L was observed during the operational period.

The observed PAH concentration (28,444 micrograms per liter [$\mu\text{g/L}$]) was also higher than anticipated for the facility design basis (19,800 $\mu\text{g/L}$). Observed influent concentrations of PCP (270 $\mu\text{g/L}$) were lower than design concentrations (480 $\mu\text{g/L}$). Sufficient data on individual EW concentrations are not available to determine why these plant influent concentrations are changing over time. It might be a residual impact from the 2001 steaming operations, or the level of hydraulic containment has an impact on the extracted water constituent concentrations. Another possible cause could be the amount of precipitation that the site receives. A significant sampling effort and EW pump rate evaluation would be required to determine the potential causes of variations in the extracted groundwater concentrations.

TABLE 1-3

EQ Tank Influent Concentrations

GWTP Performance Evaluation Report -- Wyckoff/Eagle Harbor Superfund Site

Parameter	Design Influent Concentration	Observed Influent Concentration
O&G (mg/L)	19	26.7
PCP ($\mu\text{g/L}$)	480	270
PAH ($\mu\text{g/L}$)	19,800	28,444

NOTES:

O&G = oil and grease

PCP = pentachlorophenol

PAH = polycyclic aromatic hydrocarbon

mg/L = milligrams per liter

 $\mu\text{g/L}$ = micrograms per liter

As shown in Table 1-4, the observed O&G concentration of the EQ Tank effluent was 50 percent of the plant influent concentration, indicating the EQ Tank achieved a significant removal of O&G. The calculated removal rate would be significantly higher if the recycle waste streams were sampled to determine the impact of the recycle waste streams on overall EQ Tank performance. However, even without taking into consideration the impact on the performance of the EQ Tank from the recycle streams, the EQ Tank is removing 50 percent of the O&G associated with the well field extracted groundwater. The design basis for the EQ Tank assumed that no O&G removal would occur in the EQ Tank because of the recycle flow stream impacts. Therefore the EQ system O&G removal to date is better than the design expectation.

The total removal of O&G is approximately 3.75 pounds per day (lb/day). TSS data are not available for the plant influent; therefore, it is not possible to calculate the quantity of settled material that is being removed by the EQ Tank. Similarly, no PAH or PCP data are available for the EQ effluent, so it is not possible to calculate the removal efficiencies of these constituents. However, given the amount of O&G removed in the EQ Tank, it is safe to assume that PAH removal is also significant.

TABLE 1-4
EQ Tank Performance Evaluation
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Parameter	Design Influent Concentration	Observed Influent Concentration ¹	Design Effluent Concentration	Observed Effluent Concentration ¹
O&G (mg/L)	19	26.7	20	13.6
TSS (mg/L)	30	ND	28	5

NOTES:

1 – Total average based on monthly average data results, April 2009 through December 2010.

O&G = oil and grease

TSS = total suspended solids

mg/L = milligrams per liter

ND = no data

High influent loading periods for the EQ Tank were observed in May 2009 and June 2009. During these months, EQ Tank O&G influent concentrations increased to 126.1 mg/L and 93.6 mg/L, respectively. The O&G grease removal rates during these months were 91 percent and 89 percent, respectively.

2.0 DAF System

2.1 Overview

The DAF system follows the EQ system and precedes the HDBF system. The DAF system removes suspended solids and non-aqueous-phase oils (LNAPL and DNAPL) from the flow stream. The design influent flow rate from the EQ system is 75 gpm, with an effluent flow rate to the HDBF of 70 gpm; approximately 5 gpm of oil and settleable solids are removed from the DAF Tank as a result of skimming and sludge removal. The principal removal mechanism in the DAF unit and its air saturation system is flotation of oil and settleable solids that are then removed as sludge. A polymer is injected into the DAF influent (DI) to improve the oil removal efficiency.

The DAF system components include the following:

- DAF Tank
- Supplemental components of DAF system consisting of skimmer, auger, mixer, recirculation pump, air saturation tank, and DAF control panel
- DAF Polymer Feed system
- DAF feed pumps (2)

Figure 2-1 in Appendix A is a screen shot of the operator control screen showing a mechanical system schematic of the DAF system. The DAF system consists of a flotation chamber, a motor-driven float drag skimmer and a float collection chamber, an effluent chamber, a motor-driven sludge auger, a recycle pressurization system (recirculation pump, Air Saturation Tank), mixer, and local control panel.

The DAF process is important to make sure that significant quantities of non-aqueous-phase oil are effectively removed from the flow stream, which is critical to prevent fouling and allow proper operation and performance of the HDBF and GAC processes.

The DAF Polymer Feed system consists of a neat polymer pump, polymer mixer, an in-line mixer, a Polymer Blend Tank, and a polymer feed pump.

The DAF Polymer Feed system prepares a diluted polymer solution and injects the solution into the DI (prior to the DAF system). Polymer addition via the DAF Polymer Feed system improves the oil and solids removal performance of the DAF system. Concentrated polymer is obtained from the manufacturer in drum quantities. Nonpotable water (W2) is supplied from the Plant Water Storage Tank. Polymer and water are mixed in the polymer mixer and the solution is stored in the Polymer Blend Tank. Polymer solution is injected into DI piping by the Polymer feed pump. During plant optimization the polymer dosage rate was increased from the designed concentration of 0.5 parts per million (ppm) to 1.7 ppm based on DAF performance during the shakedown period.

SP-1 is located immediately upstream from the DAF feed pumps to sample the influent to the DAF unit before the polymer is injected into the DI flow stream. Sampling port SP-2 (see Figure 1-1) is located after the DAF unit to sample processed water from the DAF effluent chamber.

Flow from the DAF system goes to the HDBF system, which is described in Section 3.0.

2.2 Design Parameters

Table 2-1 lists performance criteria for the DAF system. Design parameters are listed in Table 2-2.

TABLE 2-1

DAF System Performance Criteria

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Parameter	Design Influent Concentration	Design Effluent Concentration
TSS (mg/L)	28	10
O&G (mg/L)	20	14
PCP (µg/L)	435	405
PAH (µg/L)	17,955	8,977

NOTES:

TSS = total suspended solids

O&G = oil and grease

PCP =pentachlorophenol

PAH = polycyclic aromatic hydrocarbon

mg/L = milligrams per liter

µg/L = micrograms per liter

TABLE 2-2

DAF System Design Parameters

GWTP Performance Evaluation Report -- Wyckoff/Eagle Harbor Superfund Site

DAF Air Flotation Unit	
Number of Units	1
Dimensions	18 ft L x 6 ft W
Capacity	8,500 gallons
Design Flowrate	11 to 90 gpm
Effluent Chamber Capacity	400 gallons
DAF Polymer System	
Neat Polymer Supply Tank Capacity	100 gallons

TABLE 2-2

DAF System Design Parameters

GWTP Performance Evaluation Report -- Wyckoff/Eagle Harbor Superfund Site

Polymer Blend Tank Dimensions	6 in Dia x 21.75 H
Polymer Feed Pump Capacity	8 gph
DAF Feed Pumps	
Number of Units	2
Type	Variable speed, horizontal progressive cavity
Capacity	80 gpm @ 5 ft of Head
Horsepower	3.0 hp
NOTES:	
gpm = gallons per minute	
gph = gallons per hour	
hp = horsepower	

2.3 Process Description

- Groundwater is pumped from the EQ system to the DAF system by one of the two DAF feed pumps.
- DI enters the inlet mixing chamber where it is mixed with recycled DAF effluent that has been supersaturated with air under pressure in the saturation chamber. The mixer speed is operator adjustable and has been operating at a setting of 50 percent speed.
- As water passes into the flotation chamber and the pressure on the recycled stream is released, minute gas bubbles form and rise to the surface, carrying suspended solids and oil droplets that adhere to the bubble surfaces. This material forms a “float” or froth at the liquid surface, which is removed by the skimmer by means of traveling up the dewatering beach and discharging into the float collection chamber. The skimmer speed is operator adjustable and has been adjusted to a setting of 35 percent speed during plant optimization.
- Polymer is injected into the DI to enhance flotation performance. The polymer feed rate has been optimized to 1.7 ppm.
- Heavy materials such as DNAPL and solids settle out in the V-bottom section of the DAF Tank and are conveyed to the center of the tank by a screw auger.
- Treated water flows under a baffle and over a level-control weir into a collection launder, and discharges to the DAF effluent chamber.
- Froth and sludge are pumped to the Froth Tank by one of two froth pumps. Froth pump stroke settings are manually set at approximately 10 percent. This setting has

been determined to provide an adequate pumping rate required to maintain the DAF froth tank level. This stroke length also eliminates the froth pumps from vapor locking which occurs when the pumps are run at too short of a stroke setting. Froth is pumped from the DAF daily. Sludge is pumped from the DAF daily during the weekdays (Monday through Friday) for approximately 30 minutes.

2.4 Performance Evaluation

Sampling data analysis and performance calculations are shown in Tables B-1 and B-2 in Appendix B. In Table B-2, the performance efficiency of each system is evaluated based on percentage (%) removal and pound (lb) removal of each constituent.

A comparison of design and observed TSS and O&G concentrations through the DAF system is provided in Table 2-3.

TABLE 2-3

DAF System Influent and Effluent Concentrations

GWTP Performance Evaluation Report -- Wyckoff/Eagle Harbor Superfund Site

Parameter	Design Influent Concentration	Observed Influent Concentration ¹	Design Effluent Concentration	Observed Effluent Concentration ¹
TSS (mg/L)	28	5	14	7
O&G (mg/L)	20	13.6	10	6.5

NOTES:

1 – Total average based on monthly average data results, April 2009 through December 2010.

TSS = total suspended solids

O&G = oil and grease

mg/L = milligrams per liter

Design concentrations were substantially higher than observed results. This is likely a result of higher than anticipated EQ system efficiency.

As shown in Table 2-4, the average removal percentage of O&G by the DAF system for the monitoring period is 46 percent, or about 168 pounds of O&G per month. This is slightly less than the design removal efficiency of 50 percent. The lower than design removal efficiency can be attributed to the low O&G influent concentrations. DAF systems will perform more efficiently when higher influent concentrations are present.

TABLE 2-4

DAF System Performance Evaluation

GWTP Performance Evaluation Report -- Wyckoff/Eagle Harbor Superfund Site

Removal	Oil & Grease	Total Suspended Solids
%	46	-43
Pounds/month	168	-27

The average monthly performance of the DAF system for O&G is plotted in Figure B-1 in Appendix B. The DAF system removed the highest amount of O&G in December 2010, about 557 pounds total for the month. The average influent O&G concentration for December 2010 was also the highest at 26.2 mg/L. The removal efficiency during December 2010 of 79 percent, versus the average removal efficiency of 46 percent, shows that the DAF system is capable of high removal rates of O&G when significant concentrations are present in the influent flow stream. It is critical to remove O&G at this point in the system to protect the HDBF and GAC systems. The increased concentration of O&G was likely a result of the high groundwater extraction rate and stormwater infiltration experience at the site in December 2010.

The DAF system was designed to remove 50 percent of TSS; however, sampling data suggest negative removal efficiencies. The reason for this error is the growth of scum and biological film in the effluent chamber walls that significantly affects the effluent sample. These biological solids grow on the effluent chamber walls. They periodically slough off the walls and then are collected when sampling the DAF effluent. These biological solids in the effluent sample result in a significant impact on the TSS concentration because the effluent sample contains extremely small concentrations of suspended solids associated with the extracted groundwater. Therefore, any contribution of biological solids has a significant impact on the effluent concentrations. No solids are added to the DAF process, so it is not possible to increase solids concentrations other than the contribution of biological growth within the DAF equipment.

3.0 HDBF System

3.1 Overview

The HDBF system follows the DAF system in the Wyckoff GWTP and precedes the GAC system. The principal function of this filtration system is to remove suspended solids from DAF system effluent. This protects the carbon beds from fouling. The design influent flow rate from the DAF is 70 gpm, with an effluent flow rate to the GAC system of 70 gpm.

Although this filter is designed to remove solids, the system will also remove non-aqueous phase oils (LNAPL and DNAPL) that are not removed by the DAF system. An automatic backwash cycle is incorporated into the HDBF system to prevent the buildup of solids and NAPL in the filter media.

HDBF system components include the following:

- Deep bed filter
- Filter feed pumps (2)
- Backwash pumps (2)

Backwash supply water is provided from the Effluent Tank and is transferred to the filter for backwashing. After completing the backwashing procedure, the cleaned media filter is forward flushed and then placed online for regular filtration.

Sampling port SP-3 (see Figure 1-1) is located to sample contaminated water from the DAF system prior to entering the HDBF system. Sampling port SP-4 (see Figure 1-1) is located to sample filtered water from the filter system prior to entering the GAC system. Sampling port SP-15 is located on the backwash effluent side to determine the clarity of the backwash water.

Flow from the HDBF system goes to the GAC system, which is described in Section 4.0.

3.2 Design Parameters

Table 3-1 lists performance criteria for the HDBF system. Design parameters for the HDBF system are listed in Table 3-2.

TABLE 3-1

HDBF System Performance Criteria

GWTP Performance Evaluation Report -- Wyckoff/Eagle Harbor Superfund Site

Parameter	Design Influent Concentration	Design Effluent Concentration
TSS (mg/L)	14	7
O&G (mg/L)	10	7
PCP (µg/L)	405	360

TABLE 3-1

HDBF System Performance Criteria

GWTP Performance Evaluation Report -- Wyckoff/Eagle Harbor Superfund Site

PAH (µg/L)	8,977	6,015
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NOTES:

TSS = total suspended solids

O&G = oil and grease

PCP =pentachlorophenol

PAH = polycyclic aromatic hydrocarbon

mg/L = milligrams per liter

µg/L = micrograms per liter

TABLE 3-2

HDBF System Design Parameters

GWTP Performance Evaluation Report -- Wyckoff/Eagle Harbor Superfund Site

Deep Bed Filter Unit	
Number of Units	1
Dimensions	3 ft Dia. x 11 ft H
Capacity	207 gallons
Filter Media	12/20 mesh black walnut shells
Filter Feed Pumps	
Number of Units	2
Type	Variable speed, horizontal centrifuge
Capacity	70 gpm @ 158 ft of Head
Horsepower	7.5 hp
Backwash Pumps	
Number of Units	2
Type	Horizontal centrifuge
Capacity	330 gpm @ 69 ft of Head
Horsepower	15 hp
NOTES:	
gpm = gallons per minute	
hp = horsepower	

3.3 Process Description

- DAF effluent is pumped through the media filter by one of the two filter feed pumps. The effluent enters the top of the vessel, flows through the media, and discharges from the bottom of the vessel to the GAC system.

- The HDBF system requires backwashing on a frequent basis. The backwash sequence is initiated by one of three predetermined levels: a differential pressure set point (set at 20 pounds per square inch differential [psid]), filtration timer timing out (set at 24 hours), or by pressing the manual backwash button, whichever occurs first. The filtration timer was originally set at 12 hours. During the shakedown period, however, a cycle time of 24 hours was determined to be optimal since the backwash will occur at the same time every day. Typically the HDBF will initiate a backwash based on the 24-hour filtration cycle. The differential pressure typically builds to 3 to 6 psid before the new backwash cycle is initiated.
- Backwashing consists of the following steps:
 - Backwash pumps pump backwash water from the Effluent Tank at 80 gpm into the bottom of the vessel to expand the bed and flush solids from the media. Dirty backwash water and solids exit the top of the vessel and are conveyed to the Dirty Backwash Water Tank.
 - When the backwash cycle is complete, the forward flush operation begins. Backwash water is pumped to the top of the vessel to settle the bed properly. Dirty forward flush water and solids exit the bottom of the vessel and are conveyed to the Dirty Backwash Water Tank.

3.4 Performance Evaluation

Sampling data analysis and performance calculations are shown in Tables B-1 and B-2 in Appendix B. In Table B-2, the performance efficiency of each system is evaluated based on percentage (%) removal and pound (lb) removal of each constituent.

A comparison of design and observed TSS and O&G concentrations through the HDBF system is provided in Table 3-3.

TABLE 3-3

HDBF System Influent and Effluent Concentrations

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Parameter	Design Influent Concentration	Observed Influent Concentration ¹	Design Effluent Concentration	Observed Effluent Concentration ¹
TSS (mg/L)	14	7	7	5
O&G (mg/L)	10	6.5	7	5.2

NOTES:

1 – Total average based on monthly average data results, April 2009 through December 2010.

TSS = total suspended solids

O&G = oil and grease

mg/L = milligrams per liter

Design concentrations were substantially higher than observed results. This is likely a result of higher than anticipated EQ Tank efficiency, which had a similar impact on the DAF system, as previously discussed.

As shown in Table 3-4, the average removal percentage of O&G by the HDBF system is 19.09 percent, or about 26.25 pounds per month.

TABLE 3-4

HDBF System Performance Evaluation

GWTP Performance Evaluation Report -- Wyckoff/Eagle Harbor Superfund Site

Removal	O&G	TSS
%	19	31
Pounds/month	26	43

The HDBF system was designed to remove approximately 30 percent of O&G. The highest removal efficiency of O&G (46%) occurred in April 2010 when the DAF effluent concentrations were also at their highest levels (9.6 mg/L). This shows that the HDBF O&G removal efficiencies are highly affected by the influent concentrations.

The TSS removal efficiency is 31 percent, or about 43 pounds per month. This is also less than the designed removal efficiency of 50 percent. Differences from design removal efficiencies are a result of the low influent values of both O&G and TSS into the HDBF system.

The average monthly performance is plotted in Figures B-2 and B-3 in Appendix B.

4.0 GAC System

4.1 Overview

The GAC system follows the HDBF system in the Wyckoff GWTP and precedes the Effluent Tank. The GAC system removes aqueous-phase (dissolved) PAHs and PCPs from solution via adsorption onto the carbon media. The GAC system is designed to process 70 gpm of HDBF effluent flow. The GAC system will also remove any residual non-aqueous-phase oil and suspended solids, although this is not its primary function. The DAF and HDBF systems are included in the treatment train to remove these constituents and avoid fouling the GAC media. The GAC system is the last treatment process in the sequence; therefore, PAH and PCP levels in the GAC system effluent should be lower than the National Pollutant Discharge Elimination System (NPDES) permit discharge limits (Appendix C, NPDES Permit). A backwash cycle is incorporated into the GAC system to remove the buildup of solids and O&G in the carbon in order to extend the operating life of the carbon.

GAC system components include five GAC adsorbers identified as GAC-1, GAC-2, GAC-3, GAC-4, and GAC-5. Backwash supply water is provided from the Effluent Tank using backwash pumps and is transferred through the GAC adsorbers.

Sampling ports SP-05, SP-06, SP-07, SP-08, SP-09, and SP-10 (see Figure 1-1) are located to sample treated water from each of the five carbon adsorbers and from the common effluent to check that contaminant levels are below discharge levels and to determine when carbon change-out is warranted. Sampling port SP-16 is located on the backwash effluent side to determine the clarity of water and shut down backwash operations.

4.2 Design Parameters

Table 4-1 lists performance criteria for the GAC system. Design parameters for the GAC system are listed in Table 4-2.

TABLE 4-1

GAC System Performance Criteria

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Parameter	Design Influent Concentration	Design Effluent Concentration
TSS (mg/L)	7	1
O&G (mg/L)	7	1
PCP (µg/L)	360	1
PAH (µg/L)	6,015	10

TABLE 4-1**GAC System Performance Criteria***GWTP Performance Evaluation Report -- Wyckoff/Eagle Harbor Superfund Site***NOTES:**

TSS = total suspended solids

O&G = oil and grease

PCP = pentachlorophenol

PAH = polycyclic aromatic hydrocarbon

mg/L = milligrams per liter

µg/L = micrograms per liter

TABLE 3-2**GAC System Design Parameters***GWTP Performance Evaluation Report -- Wyckoff/Eagle Harbor Superfund Site***GAC Adsorbers**

Number of Units	5
Dimensions	8 ft Dia. x 7.5 ft H
Capacity	10,000 GAC (dry basis)
Surface Area	50.24 ft ²
Surface loading rate @ 70 gpm	1.4 gpm/ft ²
Surface loading rate @ 21 gpm	0.42 gpm/ft ²
Carbon Type	Tigg 5DR 0830

NOTES:

GAC = granular activated carbon

ft² = square feet

gpm = gallons per minute

4.3 Process Description

- The GAC system consists of five GAC adsorbers, of which three are in service at any given time and operated in series. The fourth and fifth adsorbers are on stand-by. The first of the three adsorbers is the lead, second is the middle, and the third is the lag adsorber. A fourth adsorber can be brought into service if deemed appropriate by the operators. HDBF effluent enters the first of the three GAC adsorbers in the system.
- Piping and valves are installed to allow different possible sequencing permutations for operating three GAC adsorbers in series. GAC effluent from the three adsorber system enters the Effluent Tank.
- GAC adsorbers may be backwashed occasionally, although backwashing should be minimized and restricted to the active lead GAC adsorber under normal conditions.

- During the shakedown period, it was determined that the lead GAC adsorber is ready for backwashing when the pressure drop across the vessel is approximately 10 psid. Backwashing is also performed after new carbon is installed, to remove carbon fines. Dirty backwash water is discharged to the Dirty Backwash Water Tank.
- When it becomes necessary to replace the carbon in the lead bed, that adsorber will be taken offline for change-out. The adsorber sequence will be modified so that the former GAC-2 becomes GAC-1, the former GAC-3 becomes GAC-2, and the former stand-by bed (GAC-4) containing fresh carbon becomes GAC-3 in the series. The need for carbon change-out is determined from water sampling and analysis data.

4.4 Performance Evaluation

Sampling data analysis and performance calculations are shown in Tables B-1 and B-2 in Appendix B. In Table B-2, the performance efficiency of each system is evaluated based on percentage (%) removal and pound (lb) removal of each constituent.

A comparison of design and observed PCP and PAH concentrations through the GAC system (lag carbon effluent) is provided in Table 4-3.

TABLE 4-3

GAC System Influent and Effluent Concentrations

GWTP Performance Evaluation Report -- Wyckoff/Eagle Harbor Superfund Site

Parameter	Design Influent Concentration	Observed Influent Concentration ¹	Design Effluent Concentration	Observed Effluent Concentration ^{1,2}
PCP (µg/L)	360	262	1	0.038
PAH (µg/L)	6,015	10,929	10	0.28

NOTES:

1 – Total average based on monthly average data results, April 2009 through December 2010.

2 – Non-detects were assumed to be one-half the detection limit for calculation purposes.

PCP =pentachlorophenol

PAH = polycyclic aromatic hydrocarbon

µg/L = micrograms per liter

PAH influent concentrations were substantially higher than designed, with average monthly concentrations of 10,929 µg/L; however, the GAC system still exceeded the desired removal efficiency. The PCP influent concentration was approximately 30 percent lower than designed, with average monthly concentrations of 262 µg/L. The observed concentrations for PAH and PCP are different than the design basis as a result of the well field influent concentrations varying from the design basis, as previously discussed.

The minimal removal of both PCP and PAH across the EQ Tank, DAF system, and HDBF system prior to reaching the GAC system suggests a majority of the constituents are in the dissolved phase, because all of the upstream processes are designed to remove free- phase product.

As shown in Table 4-4, the average removal percentage of PAH by the GAC system is approximately 100 percent, or about 197 pounds per month. The PCP removal efficiency is also approximately 100 percent, or about 5 pounds per month.

TABLE 4-4

GAC System Performance Evaluation

GWTP Performance Evaluation Report -- Wyckoff/Eagle Harbor Superfund Site

Removal	Polycyclic Aromatic Hydrocarbon	Pentachlorophenol
%	100	100
Pounds/month	197	5

In Table B-2, a separate performance calculation was done to evaluate the efficiency of the lead carbon bed. The results show that its efficiency in removing PAH has recently declined significantly because of the amount of PAH that has been adsorbed onto the media; however, the PCP removal efficiency has only slightly decreased. If this trend continues, the PAH effluent concentrations will determine when the bed will need to be replaced.

The average monthly performance is plotted in Figures B-4 and B-5 in Appendix B.

5.0 Effluent Tank

5.1 Overview

The Effluent Tank follows the GAC system in the Wyckoff GWTP. A sampling station in the form of a composite sampler is located after the Effluent Tank to collect final effluent samples. Treated water in the Effluent Tank is discharged to the outfall by gravity flow. Weekly composite samples confirm that the discharged water meets the NPDES discharge requirements. Water stored in the Effluent Tank is used to backwash the HDBF and GAC systems.

Sampling port SP-10 is located prior to the Effluent Tank immediately after water from the GAC system is treated. Sample port SP-11 is located on the effluent line after the Effluent Tank to sample treated water using the composite sampler.

Flow from the effluent system discharges to the Eagle Harbor Outfall.

5.2 Design Parameters

Table 5-1 lists design parameters for the Effluent Tank.

TABLE 5-1

Effluent Tank Design Parameters

GWTP Performance Evaluation Report -- Wyckoff/Eagle Harbor Superfund Site

Effluent Tank	
Number of Units	1
Dimensions	16 ft Dia. x 22 ft H
Capacity	33,090 gallons

5.3 Process Description

- GAC system effluent is pumped to the Effluent Tank.
- The Effluent Tank discharges by overflow to the Eagle Harbor Outfall so that the tank remains full except when stored effluent is being used for backwashing.

5.4 Performance Evaluation

No process evaluation was conducted on this unit because this is an ancillary unit required to support the major process units discussed in the previous sections.

6.0 Solids Processing System

6.1 Overview

The Solids Processing system separates solids from the backwash effluent water, recycles clarified backwash water to the EQ Tank, transfers settled solids to the Digester Tank, and aerobically digests the backwash solids.

Solids Processing system components include the following:

- Dirty Backwash Tank
- Backwash recycle pump
- Digester Tank
- Digester/skim pump
- Digester sludge mixers
- Filter Press Feed Tanks (2)
- Rotary blower

Solids from filter press feed tanks are processed using the Filter Press system described in Section 7.0.

In addition to transferring the solids mixture from the digester tank to the Filter Press Feed Tanks, the digester/skim pump is also used to convey non-aqueous- phase liquids removed from the EQ Tank to the Oil Processing system described in section 8.0.

Sampling port SP-17 is located to facilitate sampling of backwash recycle water from the Dirty Backwash Tank prior to recycling to the EQ Tank and Stormwater Recycle Tank.

6.2 Design Parameters

Table 6-1 lists design parameters for the Solids Processing system.

TABLE 6-1

Solids Processing System Design Parameters

GWTP Performance Evaluation Report -- Wyckoff/Eagle Harbor Superfund Site

Dirty Backwash Tank	
Number of Units	1
Dimensions	18 ft Dia. x 14 ft H
Capacity	32,360 gallons
Backwash Recycle Pump	
Number of Units	1
Type	Variable speed, horizontal centrifuge
Capacity	115 gpm @ 28 ft of Head

TABLE 6-1

Solids Processing System Design Parameters

GWTP Performance Evaluation Report -- Wyckoff/Eagle Harbor Superfund Site

Horsepower	2 hp
Digester Tank	
Number of Units	1
Dimensions	10 ft Dia. x 23.5 ft H
Capacity	8,790 gallons
NOTES:	
gpm = gallons per minute	
hp = horsepower	

6.3 Process Description

- Used backwash water from the HDBR and GAC systems is pumped to the Dirty Backwash Tank by the backwash pumps. Occasionally, the Dirty Backwash Tank also receives water from the containment area sump (when it contains relatively high solids; otherwise the sump discharge is directed to the Stormwater Recycle Tank), and filtrate from the filter press when solids are dewatered.
- After allowing solids to settle in the Dirty Backwash Tank, supernatant is pumped by the backwash recycle pump to the EQ Tank for treatment or, alternately, to the Stormwater Recycle Tank for temporary storage.
- After sufficient solids have accumulated in the bottom of the Dirty Backwash Tank, and after supernatant has been decanted, the solids are pumped to the Digester Tank using the filter press feed pump.
- Solids undergo aerobic digestion in the Digester Tank. This is necessary to biodegrade organic material associated with the solids so that they are adequately stabilized for storage in drums for disposal.
- After the solids are sufficiently digested, a portion of the solids is withdrawn from the bottom of the digester tank for dewatering. Solids are pumped from the bottom of the Digester Tank by the digester/skim pump and discharged to the filter press feed tank.

6.4 Performance Evaluation

No process evaluation was conducted on this unit because this is an ancillary unit required to support the major process units discussed in the previous sections.

7.0 Filter Press System

7.1 Overview

The filter press system transfers amended sludge to the filter press, dewateres the sludge, neutralizes the filtrate, and recycles the filtrate to the Dirty Backwash Tank or Stormwater Recycle Tank through the containment sump.

Filter Press system components include the following:

- Filter press feed pump
- Filter press
- Filtrate Tank
- Filtrate/product disposal pump

7.2 Design Parameters

Table 7-1 lists design parameters for the filter press system.

TABLE 7-1

Filter Press System Design Parameters

GWTP Performance Evaluation Report -- Wyckoff/Eagle Harbor Superfund Site

Filter Press	
Number of Units	1
Dimensions	12 ft x 3.5 ft x 5.1 ft
Capacity	10 ft ³ , 35-60% of cake (dry weight solids)
Number of Chambers	1 head, 19 intermediate, and 1 tail
Filter Press/Digester Feed Pump	
Number of Units	1
Type	Air-Operated Diaphragm
Capacity	75 gpm @ 125 psig
Horsepower	2 hp
Filtrate Tank	
Number of Units	1
Dimensions	4 ft Dia. x 4 ft H
Capacity	350 gallons

TABLE 7-1

Filter Press System Design Parameters

*GWTP Performance Evaluation Report -- Wyckoff/Eagle Harbor Superfund Site***NOTES:**ft³ = cubic feet

gpm = gallons per minute

psig = pounds per square inch gauge

hp = horsepower

7.3 Process Description

- Dry quicklime (CaO) is added and mixed with the sludge in the Filter Press Feed Tank if the pH is less than 11. Lime is added to the solids to enhance dewatering and stabilize the sludge. Lime is added in quantities until the pH reaches 11.
- After the lime and sludge are well-mixed and the filter press prepared, the sludge mixture is pumped by the filter press feed pump to the filter press, and the filter press run is initiated. The press run continues until the filter press feed pump reaches a maximum discharge pressure, and dewatering is completed. At that time, the filter press feed pump is turned off.
- During the press run, filtrate water squeezed from the solids is discharged by gravity flow to the Filtrate Tank.
- After completion of the press run, the filter press plates are separated. Filter cake removed from the press falls through a chute into the collection bin. The filtrate pH is adjusted to near-neutral with sodium bisulfite in the Filtrate Tank.
- The neutralized filtrate is pumped from the Filtrate Tank by the filtrate/product disposal pump to the containment sump.

7.4 Performance Evaluation

No process evaluation was conducted on this unit because this is an ancillary unit required to support the major process units discussed in the previous sections.

8.0 Oil Processing System

8.1 Overview

The oil processing system further separates, manages, and removes NAPLs from the process flow stream.

Oil processing system components include the following:

- Froth Tank
- Decant pumps (2)
- Oil pump
- Product Tank
- Froth pumps (2)
- Digester/skim pump
- Filtrate/product disposal pump

Sampling port SP-12 is provided for sampling the froth from the DAF effluent. Sampling port SP-13 is located to sample froth effluent (decant water) from the Froth Tank prior to recycling to the EQ Tank. Sampling port SP-14 is located to sample product NAPL from the Froth Tank prior to entry into the Product Tank.

8.2 Design Parameters

Table 8-1 lists design parameters for the oil processing system.

TABLE 8-1

Oil Processing System Design Parameters

GWTP Performance Evaluation Report -- Wyckoff/Eagle Harbor Superfund Site

Froth Tank	
Number of Units	1
Dimensions	4 ft W x 13 ft L x 6 ft H
Capacity	2,330 gallons
Decant Pump	
Number of Units	2
Type	Variable-speed, horizontal centrifugal
Capacity	10 gpm @ 29 ft head
Horsepower	0.75 hp
Oil Pump	
Number of Units	1
Type	Air-Operated Diaphragm

TABLE 8-1

Oil Processing System Design Parameters

GWTP Performance Evaluation Report -- Wyckoff/Eagle Harbor Superfund Site

Capacity	15 gpm @ 11 ft head
Product Tank	
Number of Units	1
Dimensions	10 ft W x 29 ft L
Capacity	8,315 gallons
Froth Pump	
Number of Units	2
Type	Diaphragm, manual capacity control
Capacity	780 gpm @ 75 psig discharge pressure
Horsepower	2.0 hp
NOTES:	
gpm = gallons per minute	
hp = horsepower	
psig = pounds per square inch gauge	

8.3 Process Description

- Oily froth and sludge from the DAF system is pumped to the Froth Tank by one of two froth pumps. LNAPL, DNAPL, and solids skimmed from the EQ Tank are pumped either directly to the Product Tank or to the Froth Tank by the digester/skim pump.
- The Froth Tank provides time and surface area for release of air from the froth generated by the DAF unit. The Froth Tank is a three-compartment tank designed to trap LNAPL and DNAPL. The compartments are formed by an overflow weir, an underflow weir, and a final overflow weir to control water level in the first two compartments of the tank.
- DNAPL is trapped in the first compartment, and LNAPL is trapped in the second compartment of the Froth Tank. Periodically, NAPLs are drawn off from these compartments using the oil pump, which conveys them to the Product Tank.
- The Product Tank provides oil storage and further phase separation. The tank has outlets at multiple depths to allow separated water to be decanted.
- Decanted water from the Product Tank is discharged by gravity to the containment area sump and recycled back to the EQ Tank for treatment. Periodically, oil from the Product Tank is transferred to a tank truck for disposal.

- Froth Tank effluent is recycled from the third compartment of the Froth Tank back to the EQ Tank by the two decant pumps. The liquid level in the third compartment is monitored and used to control the speed of the decant pumps.

8.4 Performance Evaluation

No process evaluation was conducted on this unit because this is an ancillary unit required to support the major process units discussed in the previous sections.

9.0 Containment Area System

9.1 Overview

Containment pads are provided for outdoor tank equipment (Tank Farm containment pad) and for a truck decontamination area (decontamination pad) at the Wyckoff GWTP. The containment pads contain and collect stormwater, decontamination water, and spills. Secondary containment is provided for the outdoor process tanks and equipment. The Tank Farm containment pad provides secondary containment for the tanks and process equipment located in the outdoor containment area. The decontamination pad/sump provides containment and collection of water from truck decontamination, washdown water from spills during truck loading and unloading, and water from spills and washdown water in the treatment building. Stormwater and decontamination water are collected at a combined containment area sump.

The Stormwater Recycle Tank stores relatively clean water (stormwater) from outdoor containment areas and filter backwash water after solids sedimentation. This tank provides temporary storage of this water before it is pumped back to the EQ Tank for treatment in conjunction with influent groundwater.

Containment area and sump components include the following:

- Tank Farm containment pad
- Containment area sump
- Containment area sump pumps (2) with control panel
- Decontamination pad
- Stormwater Recycle Tank
- Stormwater recycle pump

Sampling port SP-18 is located to sample effluent from the Stormwater Recycle Tank prior to recycling to the EQ Tank

9.2 Design Parameters

Table 9-1 lists design parameters for the containment area and sump.

TABLE 9-1

Containment Area and Sump Design Parameters

GWTP Performance Evaluation Report -- Wyckoff/Eagle Harbor Superfund Site

Containment Area Sump	
Number of Units	1
Dimensions	4 ft L x 70 ft W x 5.7 ft H
Capacity	11,880 gallons
Sump Pump	

TABLE 9-1

Containment Area and Sump Design Parameters

GWTP Performance Evaluation Report -- Wyckoff/Eagle Harbor Superfund Site

Number of Units	2
Type	Variable-speed, horizontal centrifugal
Capacity	215 gpm @ 35 ft head
Horsepower	5.0 hp
Stormwater Recycle Tank	
Number of Units	1
Dimensions	13 ft Dia. x 18 ft H
Capacity	17,870 gallons
Stormwater Recycle Pump	
Number of Units	1
Type	Diaphragm, manual capacity control
Capacity	70 gpm @ 26 ft head
Horsepower	1.0 hp
NOTES: gpm = gallons per minute hp = horsepower	

9.3 Process Description

- The Tank Farm containment pad provides secondary containment for the outdoor tanks and process equipment. The decontamination pad collects water from truck decontamination, as well as washdown water from spills during truck loading and unloading.
- Water from stormwater runoff and washdown water from both containment pads, plus washwater and spills from the treatment building, discharge by gravity flow to the containment area sump.
- One of the two sump pumps pumps water from the containment area sump to either the Stormwater Recycle Tank or the Dirty Backwash Tank. Water that is relatively free of solids is directed to the Stormwater Recycle Tank, and water containing relatively high solids is directed to the Dirty Backwash Tank.
- The sump pumps are mounted on rails to facilitate removal and maintenance. Washdown water inside the treatment building is collected in trench drains and conveyed to the containment area sump. A backflow prevention device is installed to prevent backflow into the building if a tank in the tank containment pad area fails.

- The water level in the Stormwater Recycle Tank is maintained as low as possible to maximize the available storage capacity. The stormwater recycle pump pumps water from the Stormwater Recycle Tank back to the EQ Tank for treatment.

9.4 Performance Evaluation

No process evaluation was conducted on this unit because this is an ancillary unit required to support the major process units discussed in the previous sections.

Appendix A
Figures

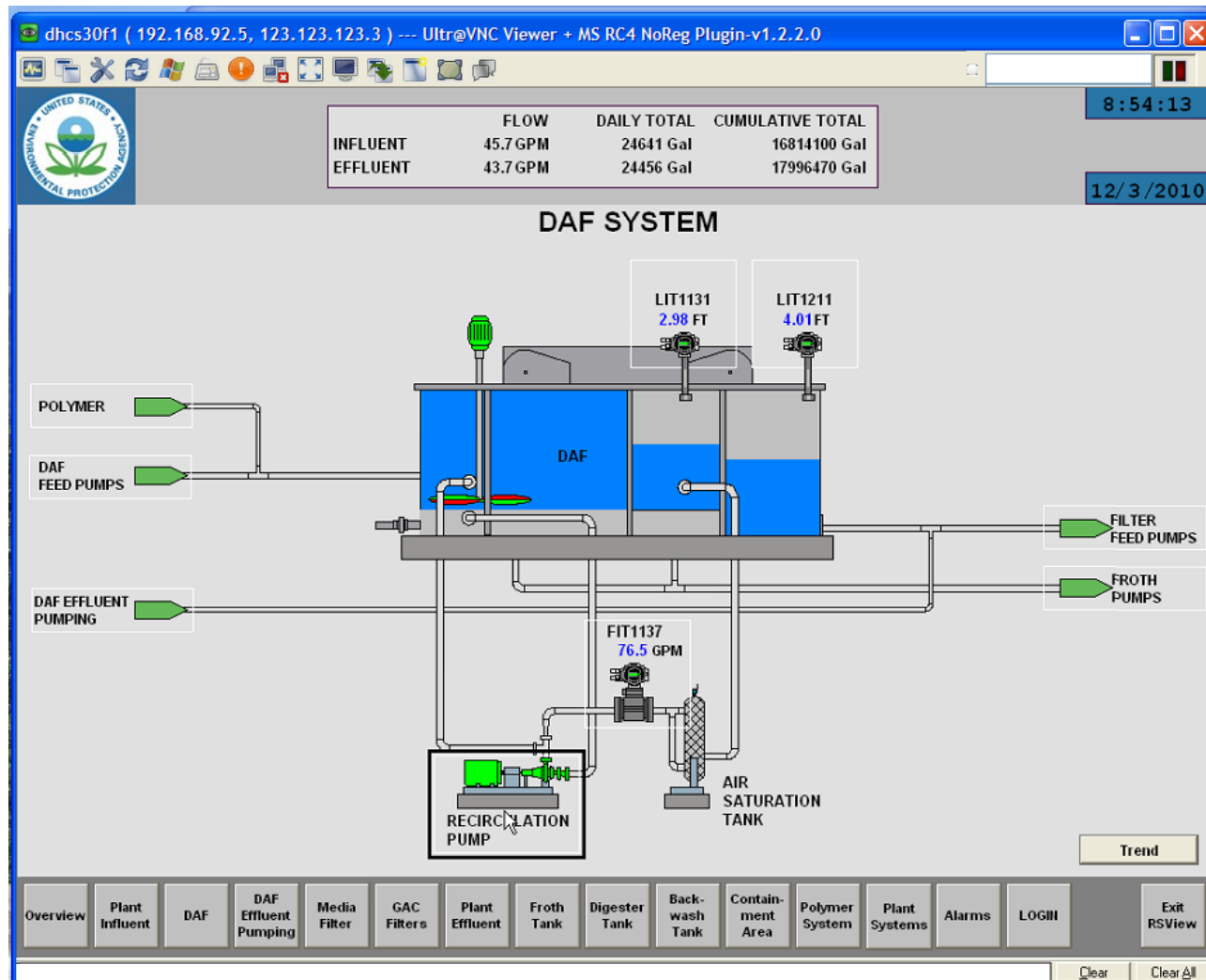


Figure 2-1. DAF System Schematic

Appendix B

Performance Evaluation Data

Table B-1. Performance Period Sampling Data

	Stream 1: Plant Influent							Stream 2: DAF Influent					Stream 3: DAF Effluent				
Design Flowrate (GPM)	63							75					70				
Month	Ave. Flow	Total PAH		PCP		O&G		Ave. Flow	O&G		TSS		Ave. Flow	O&G		TSS	
	GPM	µg/L	lb/day	µg/L	lb/day	mg/L	lb/day	GPM	mg/L	lb/day	mg/L	lb/day	GPM	mg/L	lb/day	mg/L	lb/day
April-09	31	39,751	14.64	220	0.08	36.1	13.28	37	9.2	4.06	2	1.00	32	5.9	2.25	4	1.34
May-09	32	112,602	42.81	268	0.10	126.1	47.94	38	11.6	5.28	5	2.39	33	6.2	2.46	6	2.38
June-09	26	75,530	23.63	200	0.06	93.6	29.28	32	10.1	3.93	6	2.33	27	6.7	2.20	5	1.64
July-09	0	-	-	-	-	-	-	0	-	-	-	-	0	-	-	-	-
August-09	0	-	-	-	-	-	-	0	-	-	-	-	0	-	-	-	-
September-09	24	17,500	5.05	190	0.05	10.9	3.15	30	5.5	1.99	5	1.64	25	5.0	1.52	7	2.13
October-09	31	10,050	3.70	210	0.08	5.8	2.12	37	5.3	2.35	4	1.55	32	5.4	2.07	8	2.88
November-09	31	16,250	5.98	265	0.10	13.5	4.96	37	15.2	6.73	8	3.55	32	8.4	3.22	9	3.55
December-09	59	19,500	13.75	200	0.14	15.3	10.77	65	14.2	11.05	8	6.44	60	5.6	4.00	10	7.03
January-10	62	16,250	12.04	208	0.15	15.7	11.62	68	14.6	11.95	8	6.74	63	7.4	5.60	9	6.62
February-10	61	20,500	14.95	260	0.19	14.3	10.39	67	15.0	12.03	5	4.23	62	7.5	5.57	9	6.52
March-10	62	19,200	14.23	296	0.22	13.8	10.24	68	13.1	10.73	4	3.27	63	7.0	5.33	7	5.45
April-10	60	24,000	17.21	308	0.22	18.5	13.28	66	23.6	18.69	4	3.37	61	9.6	7.00	7	4.95
May-10	56	22,000	14.72	335	0.22	14.7	9.82	62	16.4	12.23	5	3.54	57	7.1	4.86	8	5.31
June-10	47	23,200	13.12	340	0.19	17.7	10.01	53	15.2	9.77	5	3.21	48	6.0	3.51	8	4.77
July-10	46	20,500	11.35	340	0.19	14.1	7.78	52	14.1	8.84	6	3.46	47	7.8	4.41	9	4.84
August-10	0	-	-	-	-	-	-	0	-	-	-	-	0	-	-	-	-
September-10	45	17,667	9.57	303	0.16	8.4	4.53	51	10.2	6.30	7	4.53	46	5.7	3.19	9	5.01
October-10	57	17,500	11.92	295	0.20	9.0	6.11	63	12.5	9.48	5	3.59	58	6.0	4.14	7	4.70
November-10	60	17,000	12.19	246	0.18	10.6	7.57	66	13.8	10.96	5	3.96	61	5.1	3.76	7	5.31
December-10	65	23,000	17.88	370	0.29	43.0	33.42	71	26.2	22.31	5	4.48	66	5.5	4.34	6	4.76
TOTAL AVERAGE	40	28,444	14.37	270	0.16	26.7	13.13	46	13.6	9.37	5	3.52	42	6.5	3.86	7	4.40

	Stream 4: Filter Effluent								Stream 5A: GAC Effluent (LEAD)					Stream 5B: GAC Effluent (LAG)				
Design Flowrate (GPM)	70								70					70				
Month	Ave. Flow	Total PAH		PCP		O&G		TSS	Ave. Flow	Total PAH		PCP		Ave. Flow	Total PAH		PCP	
	GPM	µg/L	lb/day	µg/L	lb/day	mg/L	lb/day	mg/L	GPM	µg/L	lb/day	µg/L	lb/day	GPM	µg/L	lb/day	µg/L	lb/day
April-09	32	10,931	4.20	210	0.08	5.7	2.17	2	0.77	32	0.23	0.0001	0.037	0.00001	32	0.23	0.0001	0.037
May-09	33	11,345	4.49	218	0.09	5.0	1.98	4	1.58	33	7.12	0.0028	0.206	0.0001	33	0.23	0.0001	0.055
June-09	27	11,921	3.92	190	0.06	5.5	1.81	4	1.31	27	2.80	0.0009	0.170	0.00006	27	0.23	0.0001	0.037
July-09	0	-	-	-	-	-	-	-	-	0	-	-	-	-	0	-	-	-
August-09	0	-	-	-	-	-	-	-	-	0	-	-	-	-	0	-	-	-
September-09	25	9,250	2.82	167	0.05	5.0	1.52	6	1.83	25	0.23	0.0001	0.067	0.00002	25	0.23	0.0001	0.037
October-09	32	5,000	1.92	210	0.08	5.0	1.92	6	2.11	32	0.23	0.0001	0.120	0.00005	32	0.23	0.0001	0.037
November-09	32	11,750	4.51	258	0.10	5.5	2.12	7	2.69	32	0.34	0.0001	0.360	0.0001	32	0.23	0.0001	0.037
December-09	60	11,525	8.31	188	0.14	5.1	3.64	6	4.32	60	0.76	0.0005	0.603	0.0004	60	0.23	0.0002	0.037
January-10	63	12,250	9.27	218	0.16	5.1	3.84	5	3.97	63	10.32	0.0078	2.21	0.0017	63	0.23	0.0002	0.037
February-10	62	13,000	9.68	260	0.19	5.3	3.93	6	4.10	62	83.25	0.0620	5.44	0.0040	62	0.23	0.0002	0.037
March-10	63	12,200	9.23	302	0.23	5.0	3.78	5	3.48	63	224.0	0.170	7.70	0.0058	63	0.23	0.0002	0.037
April-10	61	12,225	8.96	290	0.21	5.2	3.79	5	3.85	61	1,543	1.13	60.75	0.0445	61	0.23	0.0002	0.037
May-10	57	12,750	8.73	328	0.22	5.1	3.51	6	3.94	57	1,800	1.23	77.00	0.0527	57	0.23	0.0002	0.037
June-10	48	11,800	6.86	318	0.18	5.0	2.91	5	3.14	48	2,820	1.64	100.80	0.0586	48	0.23	0.0001	0.037
July-10	47	13,500	7.68	315	0.18	5.4	3.04	8	4.27	47	4,600	2.62	110.00	0.0626	47	0.23	0.0001	0.037
August-10	0	-	-	-	-	-	-	-	-	0	-	-	-	-	0	-	-	-
September-10	46	8,233	4.59	290	0.16	5.0	2.79	8	4.27	46	2,667	1.49	7.87	0.0044	46	0.47	0.0003	0.037
October-10	58	9,050	6.30	293	0.20	5.0	3.48	4	2.79	58	5,575	3.88	38.75	0.0270	58	0.47	0.0003	0.037
November-10	61	9,650	7.07	303	0.22	5.0	3.66	4	3.11	61	7,075	5.18	45.00	0.0330	61	0.47	0.0003	0.037
December-10	66	10,350	8.21	368	0.29	5.0	3.96	3	2.38	66	9,950	7.89	80.00	0.0634	66	0.47	0.0004	0.037
TOTAL AVERAGE	42	10,929	6.49	262	0.16	5.2	2.99	5	2.99	42	2,020	1.41	29.84	0.020	42	0.28	0.0002	0.038

NOTES:

1. Samples were not collected during plant shut down from June 5th - September 21st in 2009, and July 15th - September 7th in 2010.

2. The Plant influent flow is groundwater flow from extraction wells plus stormwater runoff (9.6 gpm). It is assumed that stormwater runoff is 2 gpm in the summer months (June - September).

3. The DAF influent flow is stream 1 plus backwash recycle (1.3 gpm) and froth tank decant recycle (5 gpm).

4. The DAF effluent flow is stream 2 minus froth tank decant recycle (5 gpm).

5. A 4th GAC bed (MID) went online on 10/27/10.

6. Non-detects were calculated as one-half the detection limit.

Table B-2. Performance Period Equipment Efficiency

Month	DAF Efficiency				Hydromation Filter Efficiency				Carbon Treatment System Efficiency				Lead GAC Efficiency			
	O&G Removal		TSS Removal		O&G Removal		TSS Removal		PAH Removal		PCP Removal		PAH Removal		PCP Removal	
	%	lb	%	lb	%	lb	%	lb	%	lb	%	lb	%	lb	%	lb
April-09	36	54	-56	-10	4	3	43	17	100	126	100	2	100	126	100	2
May-09	46	87	-14	1	20	15	33	25	100	139	100	3	100	139	100	3
June-09	34	52	17	21	18	12	20	10	100	117	100	2	100	117	100	2
July-09																
August-09																
September-09	8	14	-56	-15	0	0	14	9	100	84	100	2	100	84	100	2
October-09	-2	9	-114	-41	7	5	27	24	100	59	100	2	100	59	100	2
November-09	45	105	-16	0	34	33	24	26	100	135	100	3	100	135	100	3
December-09	61	219	-18	-18	9	11	38	84	100	257	100	4	100	257	100	4
January-10	49	197	-6	4	31	55	40	82	100	287	100	5	100	287	99	5
February-10	50	181	-67	-64	29	46	37	68	100	271	100	5	99	269	98	5
March-10	46	168	-80	-68	29	48	36	61	100	286	100	7	98	281	97	7
April-10	59	351	-59	-47	46	96	22	33	100	269	100	6	87	235	79	5
May-10	57	229	-63	-55	28	42	26	42	100	271	100	7	86	232	76	5
June-10	60	188	-64	-47	17	18	34	49	100	206	100	6	76	157	68	4
July-10	45	137	-55	-43	31	42	12	18	100	238	100	6	66	157	65	4
August-10																
September-10	44	93	-23	-15	13	12	15	22	100	138	100	5	68	93	97	5
October-10	52	165	-42	-34	16	21	41	59	100	195	100	6	38	75	87	5
November-10	63	216	-45	-40	2	3	41	66	100	212	100	7	27	57	85	6
December-10	79	557	-14	-9	9	12	50	74	100	254	100	9	4	10	78	7
TOTAL AVERAGE	46	168	-43	-27	19	26	31	43	100	197	100	5	81	154	91	4

Figure B-1. DAF Efficiency, Oil & Grease

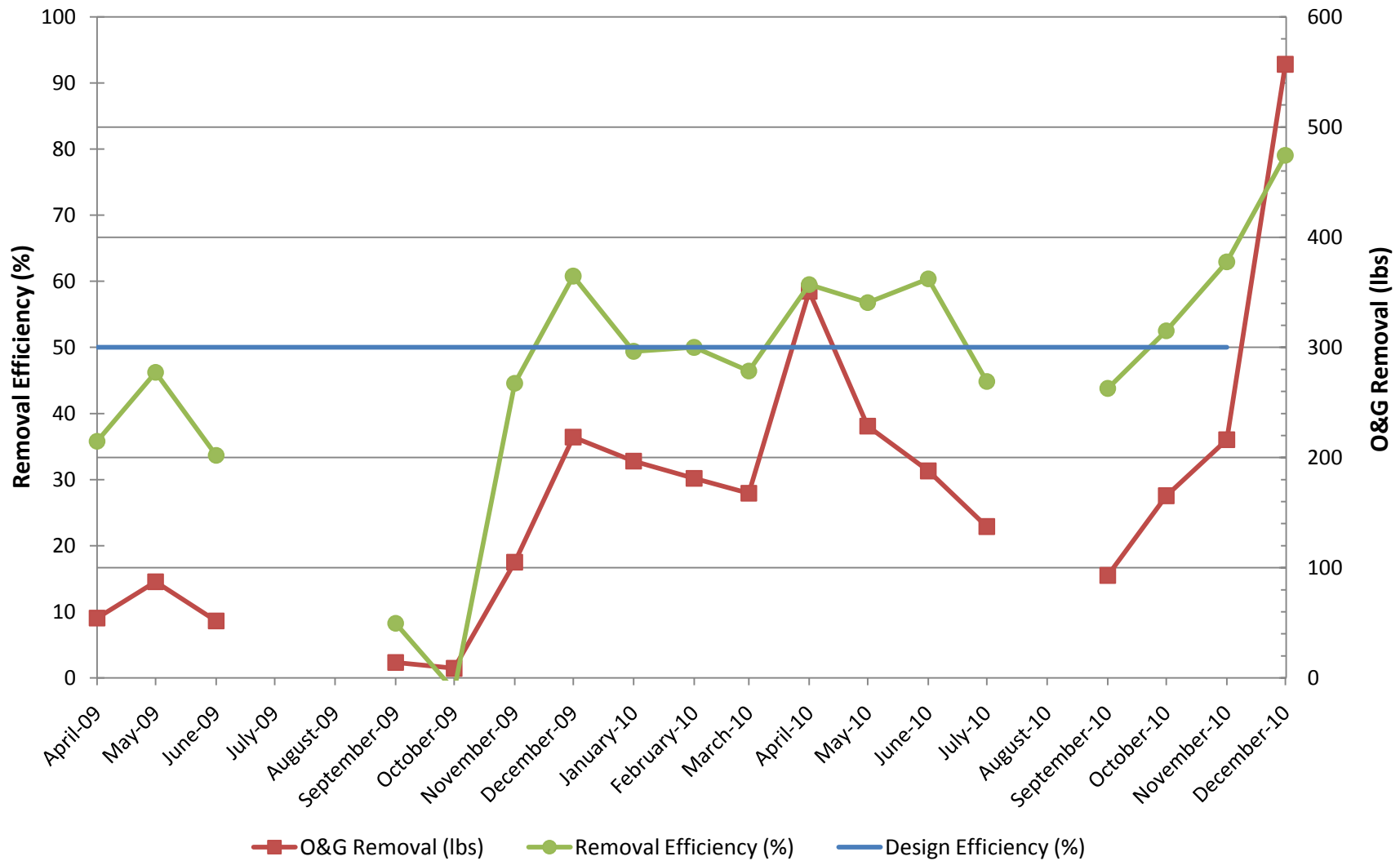


Figure B-2. HDBF Efficiency, Oil & Grease

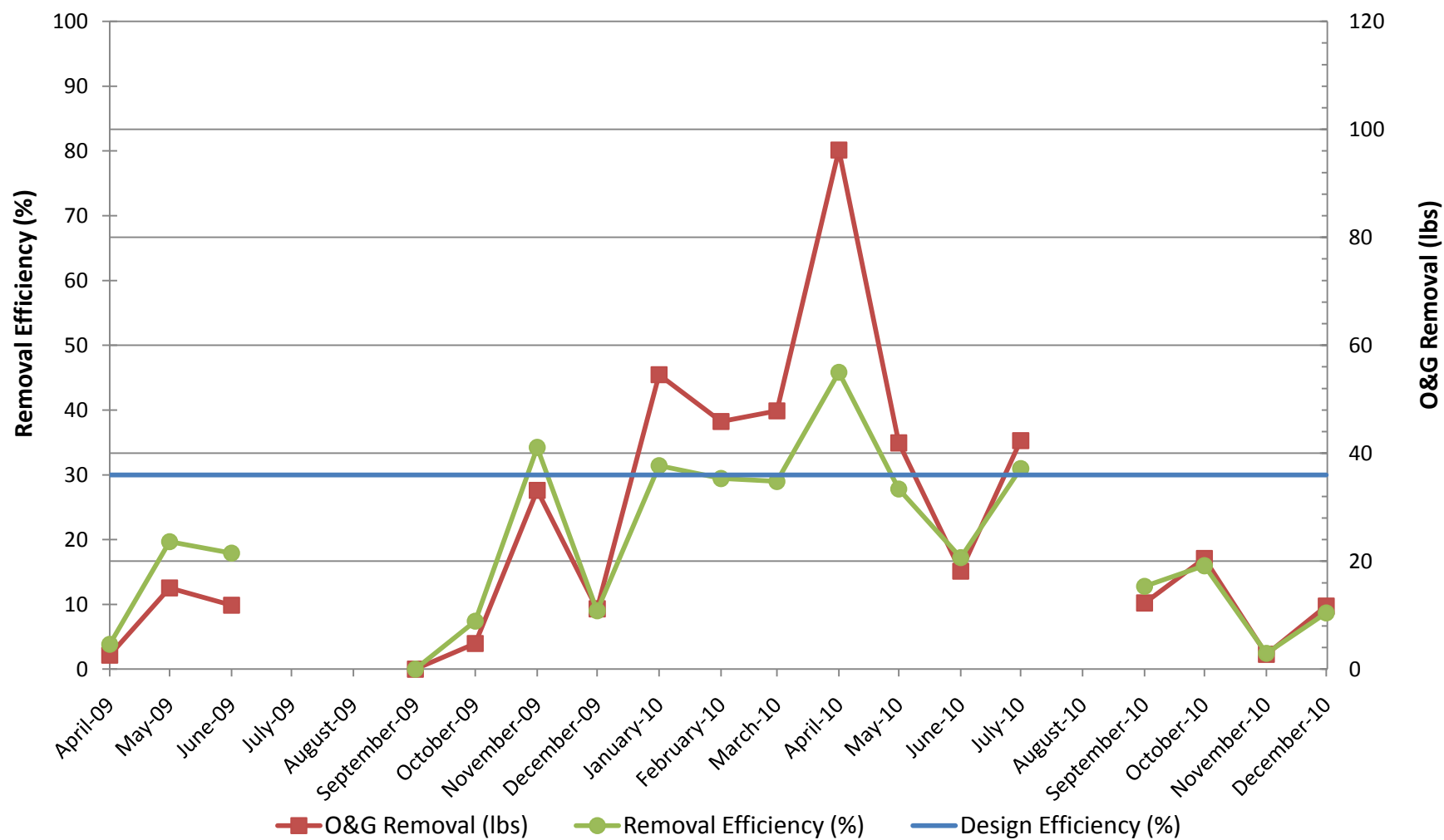


Figure B-3. HDBF Efficiency, Total Suspended Solids

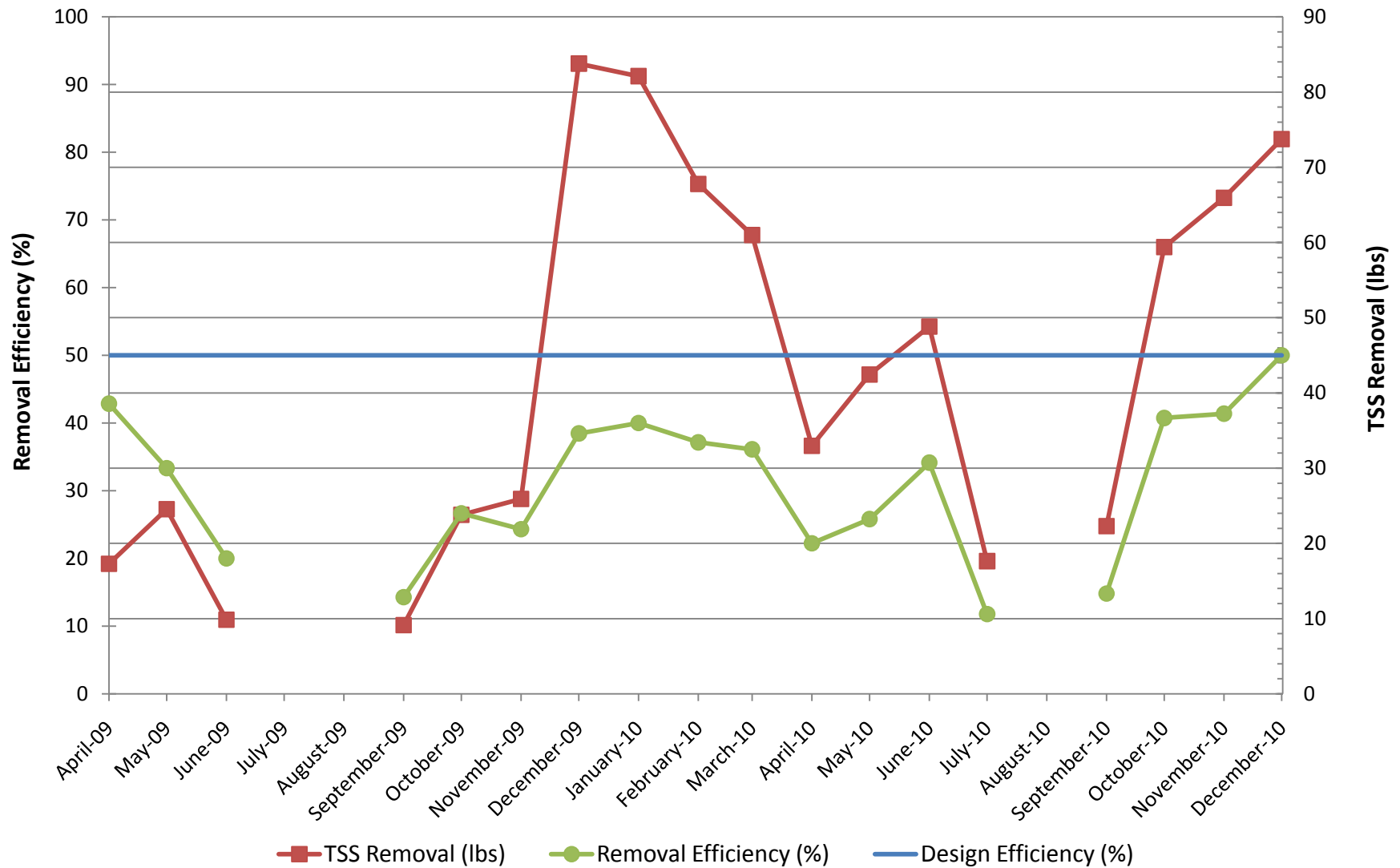


Figure B-4. GAC System Efficiency, Polyaromatic Hydrocarbons

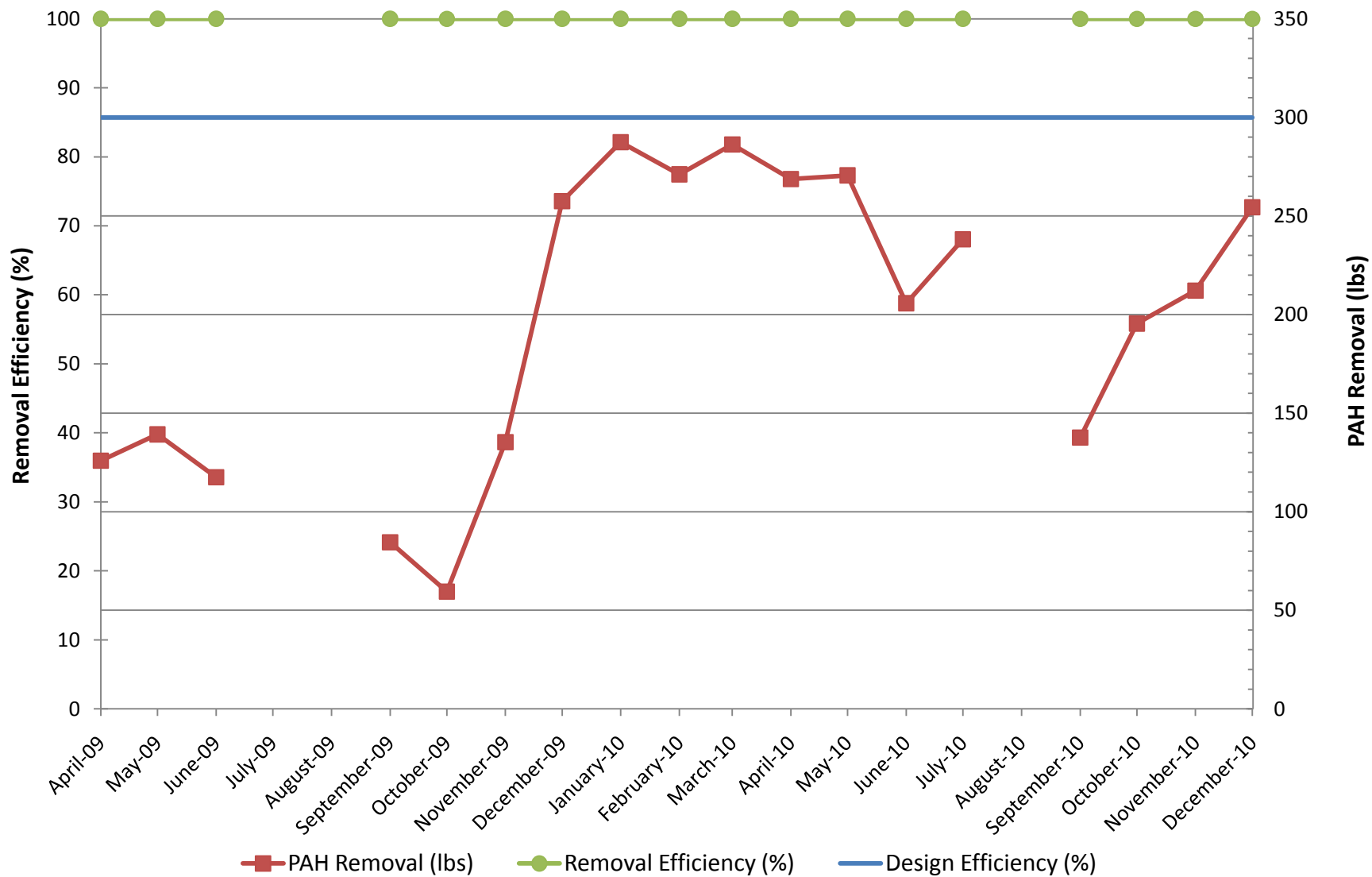
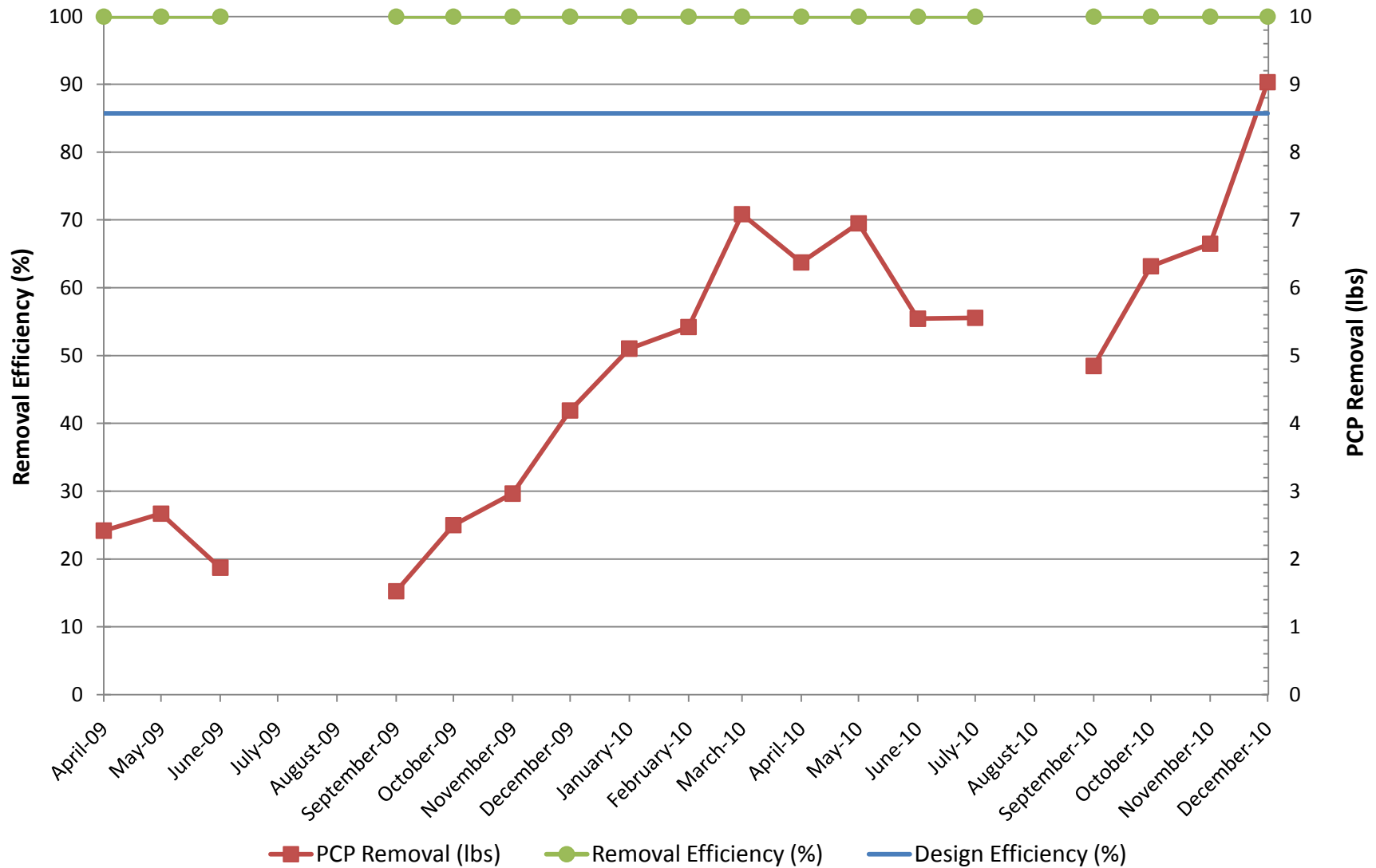


Figure B-5. GAC System Efficiency, Pentachlorophenol



Appendix C

State of Washington NPDES Requirements

Summary of Current Effluent Limitations and Monitoring Requirements (a)

CHEMICAL MONITORING

Effluent Characteristic	Discharge Limitation		Monitoring Requirements		
	Daily Maximum (ug/L)	Monthly Average (ug/L)	Measurement Frequency	Sample Type	Reported Value(s)
Total of 16 Polynuclear Aromatic Hydrocarbons (PAHs)	20	--	Once per week	24-hour composite (c)	Maximum daily
Individual PAHs (b)					
Naphthalene	4	--	Once per week	24-hour composite	Maximum daily
Acenaphthylene	4	--	Once per week	24-hour composite	Maximum daily
Acenaphthene	4	--	Once per week	24-hour composite	Maximum daily
Fluorene	2	--	Once per week	24-hour composite	Maximum daily
Phenanthrene	2	--	Once per week	24-hour composite	Maximum daily
Anthracene	2	--	Once per week	24-hour composite	Maximum daily
Fluoranthene	2	--	Once per week	24-hour composite	Maximum daily
Pyrene	2	--	Once per week	24-hour composite	Maximum daily
Benzo(a)anthracene	2	--	Once per week	24-hour composite	Maximum daily
Chrysene	2	--	Once per week	24-hour composite	Maximum daily
Benzo(b)fluoranthene	2	--	Once per week	24-hour composite	Maximum daily
Benzo(k)fluoranthene	2	--	Once per week	24-hour composite	Maximum daily
Benzo(a)pyrene	2	--	Once per week	24-hour composite	Maximum daily
Dibenzo(a,h)anthracene	2	--	Once per week	24-hour composite	Maximum daily
Benzo(g,h,i)perylene	2	--	Once per week	24-hour composite	Maximum daily
Indeno(1,2,3-cd)pyrene	2	--	Once per week	24-hour composite	Maximum daily
Pentachlorophenol (d)	6	--	Once per week	24-hour composite	Maximum daily
Discharge Flow (gpm) (e)	NA	--	Continuous	Recording	Maximum daily
Total Suspended Solids [TSS] (mg/L)	NA	--	Once per week	24-hour composite	Maximum daily
Total Dissolved Solids [TDS] (mg/L)	NA	--	Once per week	Grab	Maximum daily
Temperature [degrees C]	NA	--	Once per week	Grab	Maximum daily
Dissolved Oxygen [DO] (mg/L)	NA	--	Once per week	Grab	Maximum daily
pH	6.0 - 9.0	--	Once per week	Grab	Maximum daily
Metals (f)					
Zinc	95	47	Once per week	24-hour composite	Maximum daily
Lead	140	70	Once per week	24-hour composite	Maximum daily
Mercury	2.1	1	Once per week	24-hour composite	Maximum daily
Nickel	75	37	Once per week	24-hour composite	Maximum daily
Cadmium	43	21	Once per week	24-hour composite	Maximum daily
Chromium (Total)	1100	548	Once per week	24-hour composite	Maximum daily

BIOMONITORING (g)

Organism	Type of Toxicity Test	Monitoring Requirements		
		Measurement Frequency	Sample Type	Reported Value(s)
Inland Silversides (Menidia beryllina)	Acute survival test	Quarterly	24-hour composite	LC50
Purple sea urchin or sand dollar (h)	Chronic test	Quarterly	24-hour composite	IC25
Pacific oyster or mussel larvae (h)	Chronic test	Quarterly	24-hour composite	NOEC, LOEC, EC50/LC50

Notes:

- (a) Modified from EPA's Administrative Order for Necessary Interim Response Actions No. 1091-06-03-106 dated June 17, 1991.
- (b) Each of the 16 priority pollutants PAHs are quantified separately using EPA Method 8310 from Test Methods for Evaluating Solid Waste, Third Edition, SW-846. The 16 individual PAHs are summed to arrive at the total PAH value.
- (c) A 24 hour composite sample is collected using an automatic sampler.
- (d) Pentachlorophenol is quantified using EPA Method 8040 from Test Methods for Evaluating Solid Waste, Third Edition, SW-846.
- (e) Flow is measured by a continuous flow meter.
- (f) Metals are quantified using EPA Contract Laboratory Program (CLP) analytical methods and QA/QC, however full documentation is not required. Documentation only includes calibration, blank, accuracy, and precision results.
- (g) Specific requirements for analytical methods, QA/QC, and reporting are provided in the attached fact sheet.
- (h) These organisms may be used interchangeably if required.

Reference:

Interim ROD
Wyckoff Groundwater Operable Unit
Wyckoff/Eagle Harbor Superfund Site
September 30, 1994

Current Biomonitoring Requirements

I. Acute Toxicity Test Requirements:

1. For each test period (see also Paragraph I.8 below), acute survival toxicity tests are required for Inland Silversides (*Menidia beryllina*).
2. The test protocol is adapted from C.I. Weber, et al, *Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms*. EPA/600/4-90/027, 1991.
3. All quality assurance criteria used are in accordance with *Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms*, EPA/600/4-90/027. Test results which are not valid (e.g., control mortality exceeds acceptable level) will not be accepted and must be repeated.
4. The test is performed with a series of dilutions (100, 50, 25, 12.5, and 6.25 percent effluent) plus a control (0 percent effluent) to determine (1) the LC₅₀, and (2) any statistically significant differences between the results for the control and each effluent concentration tested.
5. If the test demonstrates the presence of acute toxicity, EPA will undertake the following actions as needed to determine the source of toxicity:
 - (a) Chemical analyses.
 - (b) Evaluation of treatment processes and chemicals used.
 - (c) Physical inspection of facility for proper operation of treatment units, spills, etc.
 - (d) Examination of records.
 - (e) Interviews with plant personnel to determine if toxicant releases occurred through spills, unusual operating conditions, etc.

If any toxicity remains after conducting the above steps, additional monitoring or treatment may be required.

6. A written report of the toxicity test results and any related source investigation are prepared for EPA within 60 days after the initial sampling. The report of the toxicity test results and chemical analyses shall be prepared in accordance with the Reporting Sections in the documents specified above in Section I-3.
7. Chemical testing for the parameters for which effluent limitations exist shall be performed on a split of each sample collected for bioassay testing. To the extent that the timing of sample collection coincides with that of the sampling required for the effluent limitations, analysis of the split sample will fulfill the requirements of that monitoring as well.
8. Testing shall be conducted every three months (4 times per year), until EPA modifies this requirement in writing. Additional toxicity testing is also required at any time that spills or other unusual events result in different or substantially increased discharge of pollutants.

II. Chronic Toxicity Test Requirements:

1. For each test period (see also Paragraph II.11 below), chronic toxicity tests are required for the following organisms:
 - (a) *Strongylocentrotus purpuratus* (purple sea urchin), or *Dendraster excentricus* (sand dollar).
 - (b) *Mytilus edulis* (mussel) or *Crassostrea gigas* (Pacific oyster) larvae.

The purple sea urchin and sand dollar, and the mussel and Pacific oyster may be used interchangeably if necessary.

2. In each year, the bioassay tests shall be conducted four times with each organism during the organism's natural spawning period. To the extent that these seasons overlap, testing shall be conducted on splits of the same effluent samples. Any tests which fail the criteria for control mortality as specified in the respective protocols shall be repeated on a freshly collected sample.
3. Testing is conducted on 24-hour composite samples of effluent. Each composite sample collected shall be large enough to provide enough effluent to conduct toxicity tests, as well as chemical tests required in Part II.10. below.

4. The chronic toxicity tests are performed as follows:
 - (a) For the purple sea urchin/sand dollar, tests are performed on a series of dilutions, plus a control (0 percent effluent). The IC_{25} value (the incipient concentration of effluent causing a 25 percent reduction in biological measurement, e.g., fertilization, is calculated. EPA has indicated that the IC_{25} is the approximate analogue to the no observable effect concentration (NOEC) of the effluent in the control water. The NOEC is that concentration of effluent for which survival, reproduction, or growth of the test organisms is not significantly different (at the 95% confidence level) from that of the control organisms (see *Technical Support Document for Water Quality-based Toxics Control*, EPA/505/2-90-001, March 1991).
 - (b) For the mussel or Pacific oyster larvae, tests are performed on a series of dilutions, plus a control (0 percent effluent). The NOEC, LOEC (lowest observable effect concentration), and the EC_{50}/LC_{50} (effective concentration [EC] at which 50 percent of the population shows sublethal effects such as reduction in growth and lethal concentration [LC] at which 50 percent of the population dies, respectively), are calculated.
5. The chronic bioassays are conducted in accordance with the following protocols:
 - (a) For purple sea urchin/sand dollar: *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms*, EPA/600/4-87/028 and The Environmental Monitoring and Support Laboratory, Cincinnati, OH, 1988.
 - (b) For mussel/Pacific oyster larvae: *Standard Guide for Conducting Static Acute Toxicity Tests Starting with Embryos of Saltwater Bivalve Molluscs*, ASTM E 724-89.
6. All quality assurance criteria used shall be in accordance with *Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms*, EPA/600/4-85-013, *Quality Assurance Guidelines for Biological Testing*, EPA/600/4-78-043, and for oyster/mussel larvae test, *Standard Guide for Conducting Static Acute Toxicity Tests Starting with Embryos of Saltwater Bivalve Molluscs*, ASTM E 724-89. The control water shall be high quality natural seawater. No exceptions will be made for artificial sea salts or concentrated brine unless Wyckoff submits data to EPA which demonstrates that the lab has reliably conducted the specified test with one of these media.
7. The results of the bioassay tests are provided to EPA within 45 days after completion of each test in accordance with the Reporting Section in *Short Term Methods for Estimating Chronic Toxicity Effluents and Receiving Water to Marine and Estuarine Organisms*, EPA/600/4-87/028, May 1988, and include any other information required by the protocols.
8. EPA and Ecology will evaluate the results to determine whether they indicate the occurrence of chronic toxicity outside the mixing zone. If it appears that this may be occurring, a toxicity evaluation and reduction plan will be prepared within 90 days. The evaluation portion of the plan may include additional toxicity testing if needed to follow up on initial results or gather information for a possible toxicity limit in the future.
9. If the sea urchin/sand dollar or mussel/oyster larvae tests prove inadequate for evaluating Wyckoff's effluent, EPA may substitute alternative tests which will provide the required toxicity information.
10. Chemical testing for the parameters for which effluent limitations exist shall be performed on a split of each sample collected for bioassay testing. To the extent that the timing of sample collection coincides with that of the sampling required for the effluent limitations, analysis of split sample will fulfill the requirements of that monitoring as well.
11. After one year, EPA may reduce the monitoring requirements to once per year, using the more sensitive species. All modifications will be approved by EPA in writing.

**Modifications to the Current Effluent Limitations
Wyckoff Thermal Remediation
Pilot Study Treatment System¹**

The following modifications will be made to the Chemical and/or Biomonitoring requirements:

1. Remove metals (zinc, lead, mercury, nickel, cadmium, and chromium) as a monitoring requirement. Metals was not used during wood-preserving operations at the Wyckoff/Eagle Harbor site. Additionally, years of sampling never detected metals in the treatment plant effluent.
2. Temperature will be monitored. Ecology believes an effluent temperature discharge of 20°C (68°F) to 25°C (77°F) would not cause a water quality violation in receiving waters of Puget Sound. A mixing zone has been established at the point of discharge. Grab samples for temperature monitoring will be taken once per week.
3. Dissolved oxygen (DO) and turbidity will also be monitored by grab samples once per week. The daily maximum discharge limitations are:

DO: Shall exceed 6 mg/L
 (the receiving waters of Puget Sound off Wyckoff are considered to be Class A Marine Water)

Turbidity: If background is < 50 ntu, discharge cannot exceed background plus 5 ntu
 If background is > 50 ntu, discharge cannot exceed a 10% increase

4. The following Measurement Frequency will be employed during the first three months of pilot study operation:
 - Daily effluent sampling for weeks 0 to 2
 - Twice a week for week 2 to month 3
 - Biomonitoring at month 3

Based on the results of the sampling data, the Measurement Frequency will be adjusted as appropriate after month 3. Any sampling adjustments made shall be no less than once per week for effluent chemical monitoring and quarterly for biomonitoring, for the remainder of the pilot study.

The above modifications will be employed during the thermal pilot study. Effluent Limitations will be developed/adjusted for the full-scale treatment system based on the results of the pilot study, as appropriate.

¹ Per agreement by the EPA Project Manager, Hanh Gold, and the Ecology Project Managers, Guy Barrett and Marian Abbett on February 2, 2000, and during subsequent communications on February 8 and 10, 2000.